naturally and inevitably follows the same course to supply his wants. He chips the flint and silicious minerals to form his spear and arrow-heads; he grinds the various stones to form his *chisels* and *axes;* he moulds the plastic clay to form his cooking utensils; and last, though not least, his aspirations for futurity indicate an innate consciousness of that great and good first cause, the Almighty hand, which formed him of the dust of the earth, and placed him in a beautiful garden, where he might have dwelt forever, if he had not fallen, by his own free will, to roam the earth,—to sink by ignorance and vice, alas! in too many cases, to that state in which STOCKS and STONES were or are his only guides or means,—the one for direction, the other for subsistence.

Stated Meeting, July 15, 1864.

Present, five members.

Mr. CHASE in the Chair.

Letters of acknowledgment were received from the Royal Society, Göttingen, January, 1864; the American Oriental Society, Boston, May, 1864, and the Lyceum of N. H., New York, March 17th, 1864.

A letter of envoi was received from the Société de Physique et d'Histoire Naturelle de Genève, March 1st, expressing a wish for full and regular exchanges, which, on motion of Mr. Fraley, was so ordered.

Letters with photographic likenesses of the authors for the Album were received from Jared Sparks, of Cambridge, Mass., May 28th, and Prof. Zantedeschi, of Padua. Mr. James presented a photograph, also, of Asa Gray, of Cambridge, Mass.

A letter to the Librarian was read from W. L. Nicholson, Esq., Topographer to the Post Office Department, correcting an error in the account of the deficiencies at Washington in the matter of United States county maps, given on page 352 of the Proceedings. Mr. Nicholson has a nearly com-

plete set of them, now on file in the United States Post Office Department, collected under the present Administration:

"On being honored with this appointment last year (coming from the Coast Survey Service), I immediately set myself to collect the best data from all quarters to have for ready reference, and to put everything into good shape, not only to keep up the current work, which is very great, owing to the changing and expanding character of the postal service, but to have the material ready for bringing out, as soon as practicable, postal maps of the United States.

"I need hardly tell you that this is a work of very great labor and nicety, your own State having over two thousand five hundred post-offices, and routes interlacing in all directions. I have more trouble with the locations of the post offices in the older States than with the new; thanks to the Land Office subdivisions.

"The Territories, however, afford choice bits of perplexity, counterbalanced, however, by the feeling of interest in the opening out and clearing up of these terræ incognitæ."

Donations for the Library were received from the Imperial Russian Government; the Imperial Geological Institute, Vienna; Royal Society, Göttingen; Dr. R. Wolf, Zurich; Société de Physique et d'Histoire Naturelle de Genève; Geological Society, Paris; the Royal, Royal Astronomical, Royal Geographical, Chemical, and Geographical Societies at London; Agricultural Society, Bath; Insane Asylums at Concord and Hartford; American Oriental Society; Silliman's Journal; New York Lyceum; Franklin Institute, Mercantile Library, Northern Home, Blanchard & Lea, and P. E. Chase, of Philadelphia; Smithsonian Institution, Census Bureau, and F. W. Seward, of Washington; and the Mercantile Library Company of San Francisco.

The Librarian called the attention of the members present to the superb volumes of the Codex Sinaiticus Petropolitanus, presented to the Society by the Imperial Government of Russia; and on motion of Mr. Fraley, the Secretaries were directed to prepare a special letter of thanks, to be signed by the officers of the Society.

The death of Mr. Benjamin Gerhard, at Philadelphia, on the 20th ult., was reported by Mr. Fraley, and Mr. E.

Spencer Miller was appointed to prepare an obituary notice of the deceased.

The death of Josiah Quincy, LL.D., at Quincy, Mass., on the 1st inst., aged 92, was announced by Mr. Lesley, and Dr. Jared Sparks was appointed to prepare an obituary notice of the deceased.

The death of Thomas Dunlap, Esq., at Philadelphia, on the 11th inst., aged 70, was announced by Mr. Fraley, and Mr. William M. Meredith was appointed to deliver an obituary notice of the deceased.

Mr. Chase read a note on the Daily Aerial Tides that are attributable to the Lunar and Solar Attraction and Variations in Temperature.

The powerful and prejudicial influence of an inveterate scientific error, is shown in the following dogmatical statement of Mr. Joseph John Murphy, an investigator who has lent useful aid to meteorological science.†

In the Edinburgh New Philosophical Journal for April, 1864, p. 183, he says: "Were the atmosphere not acted on by heat, it would be everywhere at rest, and every level surface, at whatever height, would be an isobarometric surface. . . . . The earth's rotation cannot produce currents, but it modifies them when they are produced by the action of heat."

There can be no doubt that heat is one of the causes, and in most places it is, perhaps, the principal cause, of those atmospheric disturbances which are modified by rotation, but the assumption that the atmosphere "would be everywhere at rest," except for differences of temperature, leads to palpable absurdities.‡

It may be freely admitted that Galileo, in attributing the ocean

* From the Proceedings of the American Philosophical Society.

† Mr. Murphy was an early and independent advocate of so much of Mr. WILLIAM FERREL'S theory, as explains the polar depression of the barometer by centrifugal force and friction. Mr. Ferrel's paper, which appears to have been the first publication that contained a true explanation of the equatorial as well as the polar barometric depression, of the maxima near the parallels of 30°, and of the cause of the rotatory motion of storms, was printed in the Nashville Journal of Medicine and Surgery, and afterwards in pamphlet form, in the summer of 1856. The subject was treated at greater length, in his essay on "the motion of fluids and solids relative to the earth's surface," which was published in the "Mathematical Monthly" for 1859, vol. i, p. 140, sqq.

‡ See Proc. Am. Philos. Soc., vol. ix, pp. 283–4.

tides exclusively to "the rotation of the earth, combined with its revolution about the sun," attached too much importance to the simple combination of the motions of rotation and orbital translation, but his mistake is no greater than the opposite belief, which is now too prevalent, that there is only a single influence which can produce any important tidal effects in the atmosphere.

In a former communication on the rotation-tide, I deduced "from a reference of the aerial motions to a supposed stationary earth, a law of tidal variation nearly identical with the law that is derived from a consideration of the relative attractions of two bodies revolving about their common centre of gravity."* That such should be the case, might have been reasonably expected from the dependent connection of rotation and revolution with gravity and inertia.

I was therefore led to believe that the daily lunar barometric tides might be indicated by an expression of the same general form as the monthly lunar and daily rotation tides. On investigation I am gratified at finding that such is indeed the case. If M is the barometric mean for any given day and place, and θ is the moon's altitude, observation and theory concur in demonstrating that the lunar tide may be expressed by M C (sin. θ cos. θ),† C being a constant to be determined for each station, the principal elements of which are functions of the latitude, of gravity, and of time. I subjoin, in illustration, a

TABLE OF THE AVERAGE DAILY LUNAR BAROMETRIC TIDES.

Lunar Hours.	Station.		Lunar Hours.	Station.	
	St. Helena.	Girard College.		St. Helena.	Girard College.
	in.	in.		in.	in.
0	— .00006	+ .00313	6	— .00276	— .00308
1	— .00051	+ .00341	7	— .00242	— .00339
2	— .00172	+ .00291	8	— .00121	— .00290
3	— .00253	+ .00214	9	— .00046	— .00206
4	— .00315	— .00011	10	+ .00021	+ .00013
5	— .00330	— .00144	11	+ .00035	+ .00149

* This is evidently only another form of a single element in La Place's law of the tides. I present it in this shape, both because I obtained it independently, and because it makes the resemblance to my rotation formula more striking.

† Major-General Sabine's table of the lunar tides at St. Helena, from October, 1843, to September, 1845 (Phil. Trans., 1847, p. 48), gives for the ratios of the MEAN, .497, .832, and 1, which, if averaged with the mean at Girard College, gives a general mean of .512, .858, and 1. The GRAND MEAN for the entire periods of observation at the two stations is .500, .849, and 1.

The existence of the tidal law, which, as we have seen, should produce differences in the respective ratios of .5, .866, and 1, at 1, 2, and 3 hours from the mean tide, is shown in the following

TABLE OF TIDAL DIFFERENCES AND RATIOS.

Stations.	Lunar Time.	Differences of Barometer.			Ratios.		
		1 h.	2 h.	3 h.	1 h.	2 h.	3 h.
St. Helena, 1844–46.	Before 2 h.	.00121	.00166	.00207	.585	.802	1
	After 2 "	.00081	.00143	.00158	.501	.905	1
	Before 8 "	.00121	.00155	.00209	.579	.742	1
	After 8 "	.00075	.00142	.00156	.481	.917	1
	Mean, . .	.00099	.00151	.00182	.545	.830	1*
	Mean Ratios,				.536	.841	1
Girard College, 1842–44,	Before 4 h.	.00225	.00302	.00352	.639	.858	1
	After 4 "	.00133	.00297	.00328	.405	.905	1
	Before 10 "	.00219	.00303	.00352	.602	.861	1
	After 10 "	.00136	.00300	.00328	.415	.915	1
	Mean, . .	.00178	.00300	.00340	.524	.884	1
	Mean Ratios,				.515	.885	1
Grand Mean, or Average of Mean Ratios, . .					.525	.863	1

By a partial interpolation for the true time of mean tide at St. Helena, I obtain for the ratios of the means .557, .866, and 1, corresponding precisely with theory at 2h. from mean tide. The tables furnish suggestive evidences of the effect of declination, the varying tidal influence of attraction, when acting with and against rotation, and the resistance of gravity to the tidal flow of air.

The rationale of M. Flaugergues' second and third inferences thus becomes intelligible; the phenomena of ocean tides are connected with those of the atmosphere, which are subject to fewer extraneous disturbing influences, and can therefore be more easily investigated; and the long-suspected obedience of the principal meteorological changes to fixed natural and mathematical laws, is at length made evident.

There are, therefore, manifestly four important causes of barometric disturbance: 1, rotation, with its quarter-daily phases of alternate aid and opposition to the attraction and temperature-currents, and of shifting the aerial particles to levels of greater or less density; 2, variations of temperature and vapor; 3, lunar attraction; 4, solar attraction. Among the subordinate causes, perhaps the next in order of importance is, 5, resistance of the æther, which, according

to Fresnel's theory,* is subject to the laws of inertia and attraction, as well as to those of elasticity. If his theory is correct, the terrestrial æther (or the portion which partakes of the earth's rotation), may be so modified by the planetary æther (or the portion which revolves about the sun), as to produce a resistance varying at different hours, and a consequently varying atmospheric compression, which may some time enable us to measure its own density. The solar attraction may be constantly tending to accumulate the terrestrial æther, as well as the atmosphere, in a spheroid with a major axis in the line of the radius vector, and the position of the axes, as in the case of the ocean and aerial spheroids, may be modified by rotation. It appears to me that one of the most probable results of the rotation of the earth with its atmosphere, in an æthereal medium, would be the production of two systems of oscillations, moving with the rapidity of light, one in the line of the earth's orbit, and the other in the line of its radius vector, and that those systems would be constantly so related that while one tended to retard, the other would tend to accelerate the earth's motion.

The influences of rotation and attraction can be calculated, and after deducting their amount, the problem of accounting for the residual disturbance will be simplified. Or, by taking the average of a long series of observations made at each hour of the solar day, the effects of lunar attraction may be so far eliminated, that they can be safely disregarded in attempting to fix the approximate value of the other principal disturbances.† The formula for the rotation tide has already been given, and observation appears to indicate that it is retarded about an hour by inertia; next in order of importance are the temperature and vapor tide, and the solar tide. It would be presumptuous in the present stage of our investigations, to attempt to fix the precise amount of disturbance which is attributable to each of these two tides, but from the following considerations we may derive

* It is, perhaps, hardly proper to call this "Fresnel's theory," since it follows necessarily from the conception of an extremely tenuous and elastic material fluid, such as the æther is generally supposed to be. But I believe M. Fresnel has done more than any one else to show the agreement of the hypothesis with observed phenomena, and his labors deserve to be kept in honorable remembrance.

† The absence of any long series of observations at each hour of the lunar day, prevents our eliminating the effects of solar attraction in a similar way. Nevertheless, I propose at some future time to attempt the elimination, so far as practicable with the tables at my command, in the hope of thereby effecting a more accurate determination of the temperature and vapor tide.

conjectural results, which appear to me to be more satisfactory and philosophical than any that have been heretofore obtained.

The theoretical maxima of the rotation tide, allowing an hour for the lagging of inertia, occur at 4h. and 16h.; the minima, at 10 h. and 22h. The solar attraction maxima, with the same allowance, should be found at 1h. and 13h.; the minima, at 7h. and 19h. If we assume that the attraction tidal curve is symmetrical, and regard all the deviations from symmetry as occasioned by differences of temperature and vapor, we may readily construct the following approximate

DAILY BAROMETRIC TIDAL TABLE.

	Girard College, 1842-44. Mean Height, 29.938 inches.*				St. Helena, 1844-46. Mean Height 28.2821 inches.			
Astronomical Time.	Observed Height 29 inches +	Rotation Tide.	Temperature and Vapor Tide.	Solar and Residual Tide.	Observed Height 28 inches +	Rotation Tide.	Temperature and Vapor Tide.	Solar and Residual Tide.
h.	in.	in.	in.	in.	in.	in.	in.	in.
0	.943	+.0126	—.0031	—.0045	.2985	+.0149	+.0035	—.0020
1	.927		—.0055	—.0055	.2819		+.0021	—.0023
2	.915	—.0126	—.0059	—.0045	.2660	—.0149	+.0008	—.0020
3	.909	—.0217	—.0058	—.0015	.2553	—.0258	—.0003	—.0007
4	.908	—.0252	—.0053	+.0005	.2521	—.0298	—.0010	+.0008
5	.911	—.0217	—.0075	+.0022	.2562	—.0258	—.0015	+.0014
6	.917	—.0126	—.0124	+.0040	.2642	—.0149	—.0040	+.0010
7	.925		—.0170	+.0040	.2764		—.0067	+.0010
8	.935	+.0126	—.0196	+.0040	.2899	+.0149	—.0081	+.0010
9	.942	+.0217	—.0199	+.0022	.3003	+.0258	—.0090	+.0014
10	.945	+.0252	—.0187	+.0005	.3061	+.0298	—.0066	+.0008
11	.946	+.0217	—.0122	—.0015	.3025	+.0258	—.0047	—.0007
12	.941	+.0126	—.0051	—.0045	.2913	+.0149	—.0037	—.0020
13	.938		+.0055	—.0055	.2777		—.0021	—.0023
14	.935	—.0126	+.0141	—.0045	.2646	—.0149	—.0006	—.0020
15	.933	—.0217	+.0182	—.0015	.2562	—.0258	+.0006	—.0007
16	.934	—.0252	+.0207	+.0005	.2550	—.0298	+.0019	+.0008
17	.940	—.0217	+.0215	+.0022	.2611	—.0258	+.0034	+.0014
18	.950	—.0126	+.0206	+.0040	.2737	—.0149	+.0055	+.0010
19	.959		+.0170	+.0040	.2898		+.0067	+.0010
20	.966	+.0126	+.0114	+.0040	.3048	+.0149	+.0068	+.0010
21	.968	+.0217	+.0061	+.0022	.3163	+.0258	+.0070	+.0014
22	.967	+.0252	+.0033	+.0005	.3184	+.0298	+.0057	+.0008
23	.958	+.0217	—.0002	—.0015	.3117	+.0258	+.0045	—.0007

Imperfect as these first approximations confessedly are, and probable, nay, almost certain though it be, that a large portion of the residual tide should be transferred to the temperature and vapor column,† yet

* The sum of the tides, + the mean height = observed height.

† I can see no good reason at present, for supposing the existence of a solar tide greater than .002 in., which would be equivalent to .0005, .0009, and .001, at 1,

I think the above table will be found suggestive of valuable inferences, of which the following are perhaps among the most important.

1. That the apparent osculation of the solar and residual curve near the hours of high barometer may perhaps be owing to æthereal resistance.

2. That the cumulative action of the sun upon the air and æther, may possibly render the disturbing influence of its attraction upon the atmosphere even greater than that of the moon.

3. That the paradoxical assumption of those who advocate the temperature theory of the quarter-daily tides, that a dependent relation can exist between the barometrical changes and the changes of temperature, which "appears to be DIRECT during the morning hours, and INVERSE during those of the day and evening,"* is unnecessary, useless, and unphilosophical.

4. That in intertropical and medium latitudes, the average daily barometric tide which is attributable to variations of temperature is smaller than the rotation tide.

5. That there is but one high and one low temperature tide in twenty-four hours.

6. That the effects of temperature upon atmospheric pressure reach their maximum in the evening, when the aerial absorption of heat from the sun ceases to be in excess of its radiation, and their minimum in the morning, when radiation ceases to be greater than absorption.

7. That the daily temperature tide increases, while the rotation tide diminishes, as we approach the poles.

8. That, in consequence of rotation, there should be a slight tendency to vertical ascending currents at 4h. and 16h., and descending currents at 10h. and 22h.

9. That whatever modifications the table may require, there can be no doubt of the existence of the three tides, with maxima and minima near the times specified, or of the possibility and desirability of accurately determining their magnitude.

2, and 3 hours from the mean tide. This would reduce the quarter-daily residual tide at St. Helena, to the following form :

1h.	2h.	3h.	4h.	5h.	6h.	7h.
—.0033	—.0029	—.0012	+.0008	+.0019	+.0019	+.0020

If this residual be added to the preceding column, it gives a result accordant with the 6th inference, except two disturbances, which, I think, can be easily explained, one at midnight, and the other in the hottest part of the day.

* James Hudson, Phil. Trans., 1832.

The phenomena on which these inferences are based, are all susceptible of a simple and obvious explanation, and thus, by reasoning alternately *à priori* and *à posteriori*, we elicit from a scheme of seemingly lawless confusion, the beauty of a most marvellous order.

Pending nominations Nos. 522, 523, 524, 525, were read, and balloted for.

Mr. Fraley, Chairman of the Finance Committee, moved that the Committee have authority to compromise the claim of the Society on the bond of Charles Wharton, secured by a mortgage on certain coal lands in Northumberland County, for a sum not less than four thousand (4000) dollars, and that, in the event of such compromise and settlement, the officers of the Society be authorized and directed to execute and deliver such instruments of writing as may be necessary to carry the compromise into effect, and affix and attest the seal of the Society thereto. The motion was passed unanimously.

On motion of Mr. Fraley, the sum of five hundred (500) dollars was appropriated to the Committee on the Hall for the purpose of meeting expenses incurred in the late repairs of the building, and moreover the sum of one hundred (100) dollars for binding books.

There being no further business before the Society, the ballot-boxes were examined by the presiding officer, and the following persons declared duly elected to membership in the Society:

Joseph Harrison, Esq., of Philadelphia.
John Foster Kirk, Esq., of Boston, Mass.
Prof. George H. Cook, M.D., of New Brunswick, N. J.

And the Society was adjourned.